Mechanics and efficacy of spider web construction

The efficiency and resiliency of spider webs are well documented, but little is known about web mechanics and geometries during construction. Isabelle Su et al. used a moving sheet laser and camera to automatically photograph slices of a tangle web built by the tangle web spider Tidarren sisyphoides over 7 days and then used image-processing algorithms to transform the 2D images into 3D models. The results reveal that spider web construction progresses nonlinearly, with the spider weaving the foundation of the web during the first 2 days and then more slowly reinforcing the structure with limited expansion within the initial frame. Next, the authors performed stretching simulations on the web models, finding that the web structure includes redundancies that prevent catastrophic failure and allow easy repair even during the initial stages of construction, with web strength and toughness increasing as web density increases. Projectile impact simulations showed that the web had a chance of catching prey at specific locations even during the first day of construction. According to the authors, further expansion of the experimental setup could inspire sustainable and resilient materials, construction techniques, and self-assembly strategies with artistic, architectural, and engineering applications. — M.H.

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Previously unidentified carnivorous plant lineage

A perennial herb native to the Pacific coast of North America, *Triantha occidentalis* contains flowering stems bearing sticky glandular hairs that entrap insects. Qianshi Lin et al. analyzed nutrient uptake by *T. occidentalis* to determine whether the plant is carnivorous by affixing fruit flies labeled with stable nitrogen-15 isotopes to the flowering stems. The authors traced changes in the concentration of the nitrogen isotopes and total nitrogen and compared the results with experiments on a co-occurring carnivorous plant and a noncarnivorous plant. The results showed significant uptake of nitrogen by *T. occidentalis*, with more than half of its nitrogen sourced from prey, comparable to the carnivorous plant in the same habitat. The authors also found that the glandular hairs on the stem produce phosphatase, a digestive enzyme used by many carnivorous plants to derive phosphorus from prey. The authors note that *T. occidentalis* is unusual among carnivorous plants because its insect traps lie adjacent to its insect-pollinated flowers and because it belongs to a group of monocots not known to be carnivorous. The proximity of *T. occidentalis* to major urban centers on the Pacific coast suggests that other carnivorous plants may yet be discovered in well-explored ecosystems, according to the authors. — M.H.

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Volcanism and oxygen in the Archean Eon

Prior to the global oxygenation of Earth's atmosphere around 2.4 billion years ago, geochemical records show at least one interval of localized free oxygen gas almost 100 million years earlier. The origins of this transient "whiff" of oxygen are unclear. Jana Meixnerová et al. measured the abundance and isotope ratios of mercury in the stratigraphic record from the Mount McRae Shale in Australia to track the potential relationship between volcanism and whiffs of oxygen early in Earth's history. The mercury records prior to the oxygen whiff interval are consistent with volcanic eruptions and chemical processes driven by the intense ultraviolet radiation that would have been present in the absence of an ozone layer. During the oxygen whiff interval, weathering of basalt produced by the previous volcanism likely occurred. The authors suggest that this weathering delivered nutrients, such as phosphorus, into the ocean, fueling an increase in biological productivity and the subsequent period of increased oxygenation. According to the authors, volcanism may have driven the fertilization of the ocean with phosphorus on a global scale, leading up to the first permanent oxygenation of Earth's atmosphere. — M.H.

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Satellite image of Pilbara Craton in Western Australia, the location of the Mount McRae Shale. Image credit: Jeff Schmaltz MODIS Land Rapid Response Team, NASA GSFC.
Drought causes lasting changes to the rice root microbiome

Posted on August 6, 2021
Carolyn Beans

Beneficial microbes living in and around a crop’s roots could be powerful allies in the fight to keep plants alive through droughts, especially as climate change worsens. But before scientists can harness these microbial partners to make crops more resilient, they first need to better understand how drought affects the long-term relationships between crops and the root microbiome.

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